transmitted from it to gun-cotton through very long lengths of tube. In applying gun-cotton, on the other hand, to accomplish the detonation of mercuric fulminate, it was found that this result could be attained, and through considerable lengths of tube (7 feet and upwards) by means of very much smaller quantities of gun-cotton than is needed of fulminate to induce the detonation of gun-cotton through the corresponding distances.

This want of reciprocity between two detonating agents corresponds to one even more remarkable, which was observed by the lecturer in his earlier investigations on this subject. In the first place it was found that the detonation of ¼ oz. of gun-cotton (the smallest quantity that can be thus applied) induced the simultaneous detonation of nitro-glycerine, inclosed in a vessel of sheet tin and placed at a distance of 1 inch from the gun-cotton; while with ½ oz. of the latter, the same effect was produced with an intervening space of 3 inches between the two substances. But on attempting to apply nitro-glycerine to the detonation of gun-cotton, the quantity of the former, which was detonated in *close contact* with compressed gun-cotton, was gradually increased in the first instance to ¾ oz. and subsequently even to 2 oz. without accomplishing the detonation of the latter, which was simply dispersed in a fine state of division, in all instances but one in a large number of experiments.

The force developed by the detonation of nitro-glycerine was proved to be decidedly greater than that of the fulminate, of which from 2 to 5 grains suffice for developing the detonation of gun-cotton, when it is in close contact with them. The non-susceptibility of gun-cotton to detonation by nitro-glycerine is therefore, it need scarcely be said, not ascribable to any deficiency in mechanical force suddenly applied when the nitro-glycerine is detonated.

(*To be continued.*)

INTELLECT IN BRUTES

FROM several additional letters which we have received on this subject we select the following:—

Mr. Claypole, of Antioch College, Ohio, writes:—A friend of mine is employed on a farm near Toronto, Ontario, where a horse belonging to the wife of the farmer is never required to work, but is allowed to live the life of a gentleman for the following reason: Some years ago the lady above-mentioned fell off a plank bridge into a stream where the water was deep. The horse, which was feeding in a field close by, ran to the spot and held her up with his teeth till assistance arrived, thus probably saving her life. Was this reason or instinct? Again, a gentleman engaged in the business of distilling at Cincinnati has more than once told me that the rats in his distillery are in the habit of drinking any spirits spilt on the ground or left in open vessels, and that they often become, in consequence, so tipsy that they cannot run, and are easily taken by hand. Which is this?

Mr. J. J. Furniss, of New York, writes:—Since the publication of my letter (NATURE, vol. xix. p. 385) on the evidence of reasoning power in an elephant, afforded by the fact that he thatched his back with grass when exposed to the heat of the sun, I have received additional data bearing on the subject from Mr. W. A. Conklin, the superintendent of the Central Park Menagerie. I am informed by him that he has frequently observed elephants, when out of doors in the hot sunshine, thatch their backs with hay or grass; that they do so to a certain extent when under cover in the summer time, and when the flies which then attack the animals, often so fiercely as to draw blood, are particularly numerous; but that they never attempt to thatch their backs in the winter. This seems to prove that they act intelligently, and for the attainment of a definite end. It would be interesting to learn whether elephants in their wild state are in the habit of so thatching their backs. It seems more probable to suppose that in their native wilds they would avail themselves of the natural shade afforded by the jungle, and that the habit is one which has been developed in consequence of their changed surroundings in captivity. I am also informed by Mr. Conklin that when taken to the water in summer the elephants first sprinkle their bodies all over with water, and then quench their thirst. They never so sprinkle themselves in cold weather. Their reasoning in this case seems to be, "I cool my mouth by pouring water into it, now if I pour water over my back it will cool that also." Am I not justified in calling this "abstract" reasoning?

Mr. Charles Stewart, of Tighnduin by Killin, Perthshire, sends the following story:—A few years ago I kept a collie dog named "Bodach" at my farm, for herding the milk cows, and who recognised the dairy-maid as his mistress. On her directing him to keep the cows on a certain part of a field, he would lay himself down in the centre of a line fixed by him as the proper limit. Patiently and vigilantly he would remain in quietness until any of the cows passed his limit, when he would swoop down on the trespasser, take her by the heels, and drive her back. It was wonderful in how short a time the cows came to recognise and respect the arrangement. He also came to know some of the cows by name. One of them named "Aggi" required at certain seasons to be milked oftener than the others, and the dairymaid had only to say in Gaelic "Bodach, go and bring home Aggi," when he would start for the pasture, single out Aggi, and bring her carefully home.

O. J. H. sends the following:—An ordinary domestic cat was equally fond of a friend of mine and of myself. As a test, we resolved to try the following experiment. We each held a piece of bread, of the same size, shape, &c., above the eyes of the animal. He looked at each hand and its contents alternately, attempting to solve the problem of getting at the bread without exhibiting partiality for either of his friends. He at last seemed to decide upon an expedient, for, raising himself upon his hind legs, he simultaneously seized a piece of bread in each of his front paws, and conveyed the food thus obtained to his mouth. On repeating the experiment after a lapse of some time, no difficulty was experienced in dealing with the matter, as the expedient just mentioned was resorted to without a moment's hesitation.

Prof. Nipher, of Washington University, St. Louis, U.S., writes:—A friend of mine living at Iowa City, had a mule, whose ingenuity in getting into mischief was more than ordinarily remarkable. This animal had a great liking for the company of an oat-bin, and lost no opportunity, when the yard gate and barn-door were open, to secure a mouthful of oats. Finally the mule was found in the barn in the morning, and for a long time it was impossible to discover how he had come there. This went on for some time, until the animal was "caught in the act." It was found that he had learned how to open the gate, reaching over the fence to lift the latch, and that he then effectually mystified his masters, by turning round, and backing against it, until it was latched. He then proceeded to the barn-door, and pulling out the pin which held the door, it swung open of its own accord. From the intelligence which this animal displayed on many occasions, I am of the opinion that had not discovery of his trick prevented, it would soon have occurred to him to retrace his steps before daylight, in order to avoid the clubbing which the stable boys gave him in the morning. It may be added that this animal had enjoyed no unusual educational advantages, and his owners found it to their interest to discourage his intellectual efforts as much as possible.

The Rev. George Henslow endeavours to sum up as follows from the stories that have already appeared:—I am quite ready to admit that more than one instance (notably Dr. Frost's cat, which spread crumbs to catch birds, and which is paralleled by one mentioned in Wood's "Natural History," which "chirped" like a sparrow, and so enticed and caught them), if correctly stated, and *if the motive* of the animals could in every case be proved, will completely overthrow my supposition that animals never copy us with the same or a rational purpose. I cannot help thinking, however, that such cases are very rare. Moreover, I will abandon my notion of abstract reasoning, at least, as hitherto described, for I now think that what I meant by the want of the faculty would be better described as an impotence, or, at least, a feebleness of mind in concatenating correlative ideas; or, perhaps, a want of a receptivity of the suggestiveness of things will express my meaning. On the other hand, I still see no reason for believing that animals can conceive of a purely abstract idea. Thus, "V. I." says a mule would turn on a tap, but did not turn it off again. The reason I would suggest is that *wastefulness* being an abstract conception, the mule could not entertain it. If this be correct, we may now proceed a step further. The idea of a personal *Ego* is purely abstract; hence I am led to believe that no animals can be *self-conscious*, and as a direct consequence, they cannot be either moral or immoral, but are simply automata and non-moral. Like children, they can learn by being scolded, when they displease their master, so that a conscience similar to a child's can be produced in them;

yet they cannot naturally be moral. Thus, *e.g.*, self-interest is all in all with animals, but it can never lapse into selfishness, which is the *conscious* abuse of self-interest. We "punish" a dog, but we never look upon it as a criminal. So, too, no animal can ever act unjustly towards another, because it cannot be conscious either of justice or injustice. The abstract conceptions of righteousness and justice are only applicable to acts done *under a sense of righteousness and justice*. The same remark applies to personal immoralities; so that no animal can be immoral. That animals cannot entertain abstract ideas is not at all surprising, seeing how slow children are to do the same. A somewhat grotesque illustration will show this. A class of boys was asked what conscience was. None could explain it, so the teacher defined it as "something within you that tells you when you have done wrong." A boy at once exclaimed it was a stomach-ache. On inquiry it turned out that he had stolen and eaten some unripe fruit, and doubtless felt the *remorse* of conscience accordingly! If, then, my former position be qualified, I would restate it as corrected by the cases recorded as follows:—Animals reason as we do, but always in connection with concrete phenomena whether immediately apprehended by the senses, or present to consciousness through memory; but like children they are slow to perceive the suggestiveness of things. They have, morever, no power of conceiving truly abstract ideas. Hence they cannot be self-conscious, cannot conceive of God, and can neither be moral nor immoral, but are simply non-moral automata. On the other hand, that which rescues man from being an automaton pure and simple, is his power of conceiving of abstract ideas, which enables him to be self-conscious; consequently he can conceive of a personal, *i.e.* self-conscious Deity, so that he at once becomes a responsible being, and can be positively moral or immoral.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

AT a recent meeting of the governors of Owens College, Manchester, the Committee on the proposed University charter presented a report. It appears that "negotiations have been actively carried on with the Council of the Yorkshire College, Leeds, partly by letter and partly by means of interviews between members of the respective committees. The suggestions agreed to by the Council of the Yorkshire College, Leeds, provide that the Owens College shall be named in the charter establishing the University as the first college in it; that the president and the principal of the Owens College shall be the first chancellor and vice-chancellor of the new University; that its *locus* shall be Manchester; and that in the system of proportionate representation proposed for the governing and the executive bodies of the University, the Owens College shall in either case begin with the maximum number of representatives allowed by the scheme." To obviate objection to a local name, that of Victoria University is suggested. The report and draft memorial were approved of, and the Committee were requested to make arrangements for the presentation of the memorial to the Lord President of the Privy Council at as early a date as possible, and for carrying out the other suggestions of the report, which was passed.

THE British Medical Association are getting up a memorial to the House of Commons urging the immediate institution at Oxford of a thorough medical curriculum, on the same basis as the medical schools of other English towns, in the following subjects at least:—Human anatomy, physiology of man, general pathology, materia medica, clinical medicine and surgery for beginners, State medicine, including jurisprudence and public health.

SCIENTIFIC SERIALS

American Journal of Science and Arts, April.—An opening obituary notice of the distinguished botanist, Dr. Jacob Bigelow, who died in January, aged 92, is here followed by a note in which Prof. Marsh traces the connection between the two widely divergent forms of vertebræ of the toothed birds *Ichthyornis* and *Hesperornis*. In the former the articulation of the centrum is cup-shaped; in the latter the ends of the centrum are saddle-shaped, as in ordinary birds. The third cervical vertebra of Ichthyornis, however, has a transition form, affording a ready solution of the development of the modern avian vertebra from the fish-like. The order of development of vertebræ seems this: Biconcave vertebræ (fishes and amphibians), plane vertebræ (mammals), cup and-ball vertebræ (reptiles), saddle vertebræ (birds).—The double stars discovered by Mr. Alvan G. Clark, which (except Sirius) have not been brought to the attention of astronomers generally, are the subject of a paper by Mr. Burnham.—Interesting details are furnished by Prof. Church of underground temperatures in the Comstock lode in Nevada, where are, apparently, the hottest mines in the world. (The rock in the lower levels seems to have a pretty uniform temperature of 130° F.)—Prof. Lesquereux contributes a review of Count Saporta's valuable work on the plants of the world before man, taking occasion to compare the essential characters of certain tertiary groups of the North American continent, in order to determine some points still under discussion as to their age.—Mr. Palsinger indicates a method of estimating the thickness of Young's reversing layer; and among other subjects dealt with are, the lower jaw of Loxolophodon and the presence of chlorine in scapolites.

Journal of the Franklin Institute, April.—We note here the following:—Reports of the Committee on Science and the Arts, on Ainsworth's automatic switch for railroads, and a machine for treating flax, hemp, &c.—Tests of a Baldwin locomotive, by Mr. Hill.—The Franklin Institute standard screw thread.—The Butler mine fire cut off, by Mr. Drinker. In the course of investigations described in this last paper, Mr. Drinker thought it established that coal *in situ cannot* be burned *en masse*, but that the walls of carbonaceous slaty rock inclosing solid coal *can* be burned or calcined *in situ*. The mining engineers who discussed his paper seemed generally to be of opinion that the slates in the old fire were not actually burned, but that the carbonaceous matter in them was rather subjected to a process of distillation.

THE *Jornal de Sciencias mathematicas physicas e naturaes* (No. xxiv., December, 1878) contains the following papers:—On the oblique projection of a circle, by L. P. da Motta Pegado.—Contributiones ad floram mycologicam lusitanicam, by F. de Thuemen.—Ornithological notes, by J. V. Barboza du Bocage.—On the birds of the Portuguese possessions in West Africa (continuation), by the same.—On electrical condensation and the condensing force, by A. A. de Pina Vidal.—On a new densimeter, by Virgilio Machado.

THE quarterly *Revue des Sciences naturelles* (tome vii. No. 4) contains the following original papers:—Morphological researches on the family of *Graminæ*, by D. A. Gordon.—Note on the genital organs and the propagation of some *Limacidæ*, by S. Jourdain.—Observations on the destruction and the development of the ovigerous capsule of *Blatta orientalis*, by G. Duchamp.—Catalogue of the land and river molluscs of the Hérault department, by E. Dubrueil (continuation).—Note on the soil of Montpellier, by P. de Rouville.—Note on the Pyrenees of the Aude, by M. Leymerie.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 6.—"On the Characters of the Pelvis in the Mammalia, and the Conclusions respecting the Origin of Mammals which may be based on them." By Prof. Huxley, Sec. R.S., Professor of Natural History in the Royal School of Mines.

In the course of the following observations upon the typical characters and the modifications of the pelvis in the mammalia, it will be convenient to refer to certain straight lines, which may be drawn through anatomically definable regions of the pelvis, as *axes*. Of these I shall term a longitudinal line traversing the centre of the sacral vertebræ, the *sacral axis*; a second, drawn along the ilium, dorso-ventrally, through the middle of the sacral articulation and the centre of the acetabulum, will be termed the *iliac axis*; a third, passing through the junctions of the pubis and ischium above and below the obturator foramen, will be the *obturator axis*; while a fourth, traversing the union of the ilium, in front with the pubis, and behind with the ischium, will be the *iliopectineal axis*.

The least modified form of mammalian pelvis is to be seen, as might be expected, in the Monotremes, but there is a great difference between *Ornithorhynchus* and *Echidna* in this respect, the former being much less characteristically mammalian than the latter.

The distinctive features of the mammalian pelvis have been